TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST-EFFECTIVE, IN SITU REMEDIATION OF HEXAVALENT CHROMIUM IN GROUNDWATER

Identification No.: RL-SS04
Date: September 2001

Program: Environmental Restoration
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit(s): 100-HR-3, 100-KR-4
PBS No.: RL-RC01 (RL-ER08)
Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])
TSD Title: N/A
Waste Management Unit (if applicable): N/A
Facility: N/A

***Priority Rating*:**

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

____ 1. Critical to the success of the ACPC
_X_ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
____ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

***Need Title*:** Cost-Effective, In Situ Remediation of Hexavalent Chromium in Groundwater

Need/Opportunity Category: Technology Opportunity

***Need Description*:** Cost-effective, environmentally safe and compliant in situ remediation of hexavalent chromium to reduce the risk to aquatic organisms in the Columbia River. In particular, a technology that can cost effectively treat the large dispersed area of the chromium plumes along the river is needed. (Also see Science needs RL-SS33-S, RL-SS334-S, and RL-SS36-S).

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/09

The In Situ Redox Manipulation Technology has been applied at one of the plume hot spots. Pump and treat operations at other plume locations are ongoing. Current operations for pump and treat are scheduled for review in FY05.

***Problem Description*:** The 100-H and 100-K Areas are located along the horn of the Columbia River, in the northern portion of the Hanford Site, and include three nuclear reactors previously used for plutonium production. Primary sources of contamination in groundwater are cribs, french drains, trenches, ponds, retention basins, pipelines, and waste disposal sites. Groundwater in the 100 Area ultimately discharges into the Columbia River. The principal contaminant is chromium, which occurs in two main plumes. The areal extent of the north plume is about 2,000' x 4,000' and the south plume is about 2,000' x 2,000'. Both plumes have an average thickness of about 15 feet with concentrations ranging from 60 to 600 ppb. Depth to the water table is 85 feet. A description of the groundwater plume and potential clean up scenarios is presented in a problem statement entitled "Hexavalent Chromium Contamination in Groundwater Problem Statement." This problem statement is available at http://www.bhi-erc.com/technology/tech.htm.

Hexavalent chromium has been identified as a contaminant of concern for aquatic organisms in the Columbia River. A Focused Feasibility Study/Proposed Plan (August 1995) recommended a pump and treat Interim Remedial Measure to address chromate migration from groundwater to the river. An interim ROD (April 1996) for the operable units 100-HR-3 and 100-KR-4 specified installation of a pump-and-treat systems in operable units 100-HR-3 and 100-KR-4 to intercept chromate plumes that impact the Columbia River. The objective of the Interim Remedial Measure (IRM) is protection of aquatic organisms in the river substrate from exposure to hexavalent chromium.

The In Situ Redox Manipulation barrier technology was deployed to remediate one high concentration portion of the chromium plumes. The technology injects dithionite into the aquifer to modify the oxidation/reduction potential of the aquifer and immobilize the chromium. Although the ISRM and the pump-and-treat IRM have been shown to be effective in the more concentrated portions of the plumes, technologies that can cost effectively treat the large dispersed area of the chromium plumes are still required to completely and permanently reduce groundwater concentrations to the required levels.

Chromium treatment in the vadose zone is a related need. (See also Need Title*: Cost-Effective, In Situ Remediation of Hexavalent Chromium in the Vadose Zone*.)

Benefit to the Project Baseline of Filling Need: Using the baseline pump-and-treat technology for the dilute portion of the plume is projected to require long remediation times with high operational costs. Thus, identifying and implementing a cost effective in situ treatment technology should improve the cost and schedule baseline for the project.

***Functional Performance Requirements*:** 40 CFR 141 drinking water standard of 100 ppb; Clean Water Act Ambient Water Quality Criteria of 11 μg/L measured in the pore spaces of sediment in the Columbia River. Any technique implemented to obtain above concentration goal shall not leave any toxic, ecologically damaging or dangerous residue or result in any other type

of environmentally undesirable legacy. Techniques that enable treatment along the river boundary where emplacement of the treatment is minimally intrusive over long distances is desired.

Work Breakdown Structure (WBS) No. **:** 1.4.03.1.1.04.08.08.03 (100-HR-3) 1.4.03.1.1.06.08.06.04 (100-KR-4) ***TIP No.:*** TIP 0005

Relevant PBS Milestone: PBS-MC-029

Justification For Need**:**

Technical: Testing has shown that hexavalent chromium is migrating to the Columbia River in sufficient concentration to pose a risk to aquatic organisms; in situ treatment will negate the requirement and current process of groundwater extraction and ex situ treatment to remove hexavalent chromium (in chromate form).

Regulatory: Federal Clean Water Act Ambient Water Quality Criteria of 11 μg/L; 40 CFR 141 drinking water standard of 100 ppb.

Environmental Safety & Health: Possible worker safety issues regarding handling of reducing chemicals, etc., although proper safety protocols should mitigate these concerns.

Potential Life-Cycle Cost Savings of Need (in $000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is $50M. This estimate is based on an assumed savings of 5% of the total Hanford groundwater management life-cycle cost of $1.2B.

Cultural/Stakeholder Concerns: Stakeholders are sensitive to introduction of chemicals into the vadose zone and groundwater to accomplish in situ hexavalent chromium remediation. Ecotoxicity and bio-uptake are also stakeholder concerns. Disturbance of sensitive cultural areas is also a potential concern that might limit access to the surface areas above the contaminated plumes.

Other: None.

Current Baseline Technology: Extraction of groundwater and ex situ ion exchange treatment.

Cost: Combined Budget for pump and treat IRMs at 100-HR-3 and 100-KR-4 is about $4.0M in FY02.

Waste: Spent ion exchange resin disposed on site.

How Long It Will Take: Pump and treat operations are scheduled beyond FY02

End-User: Richland Environmental Restoration Project

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